

POSIDON Science Flight Report

2016-10-18 RF04

Takeoff: 0004 UT October 18 (10:04 Oct 18 Guam local)

Landing: 0539 UT October 18 (15:39 local), duration: 5.6 hours

Mission Scientists: Eric Jensen, Ru-Shan Gao

Pilots: Tom Ryan, Dom Del Rosso

Summary:

This flight provided extensive sampling of cirrus throughout the TTL, additional tracer measurements in the air mass perturbed by typhoon Haima, sampling of an enhanced SO₂ layer in the uppermost troposphere that was predicted by GEOS5 chemical transport model, and measurements of a water vapor gradient across the leading edge of TTL cirrus over Guam. Instruments mostly performed well.

Flight Description:

On the morning of the flight, typhoon Haima was situated west and slightly north of Guam (Figure 1). The flight path took the aircraft just south of the typhoon across a forecast gradient in tropopause temperature where TTL cirrus and dehydration were expected. The GEOS5 chemical transport model also predicted enhanced SO₂ on the west end of the flight track.

The aircraft initially headed west and ascended to about 56 kft, followed by a descent to 49 kft. Abundant ice cloud was apparent throughout the TTL on these profiles. In order to better span the depth of the clouds, the bottom altitude was lowered to 48 kft, and shortly thereafter the top altitude was raised to 57 kft (Figure 2). Thin cirrus in the uppermost TTL extended all the way up to the cold-point tropopause (~53–55 kft).

On the west end of the flight track, SO₂ mixing ratios were strongly enhanced in a layer from about 16–17.5 km, with maximum values of nearly 50 pptv (Figure 3). At least qualitatively, these measurements confirmed the GEOS5 model forecast. O₃ values in the SO₂-rich layer were between 35 and 100 ppb, well above the background values of 5–20 ppb. The combination of SO₂ and O₃ data suggests an origin of Asian pollution.

On the return trip toward Guam, the tropopause temperature was warming in agreement with the forecast east-west temperature gradient (Figure 2). Cirrus was persisting throughout the TTL as the aircraft headed east. In order to measure water vapor and tracer concentrations upstream of the in situ TTL cirrus, we requested the pilots continue along the same heading beyond Guam on the return. As forecast, TTL cirrus was not detected on the profiles east of Guam.

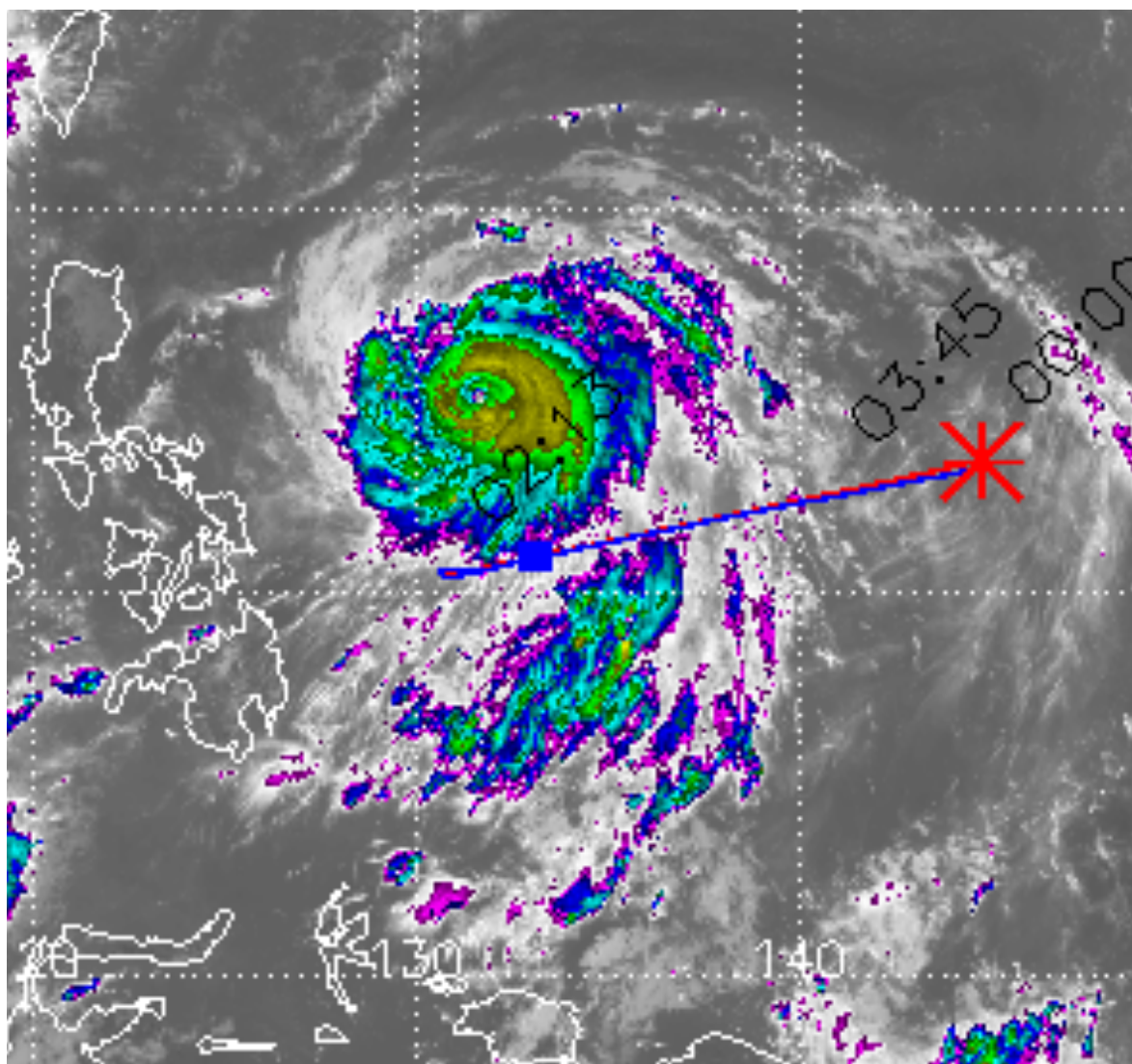


Figure 1. Infrared satellite image during the sampling of cirrus and trace gases south of tropical cyclone Haima. The red asterisk shows the location of Guam, and the flight path is shown in blue.

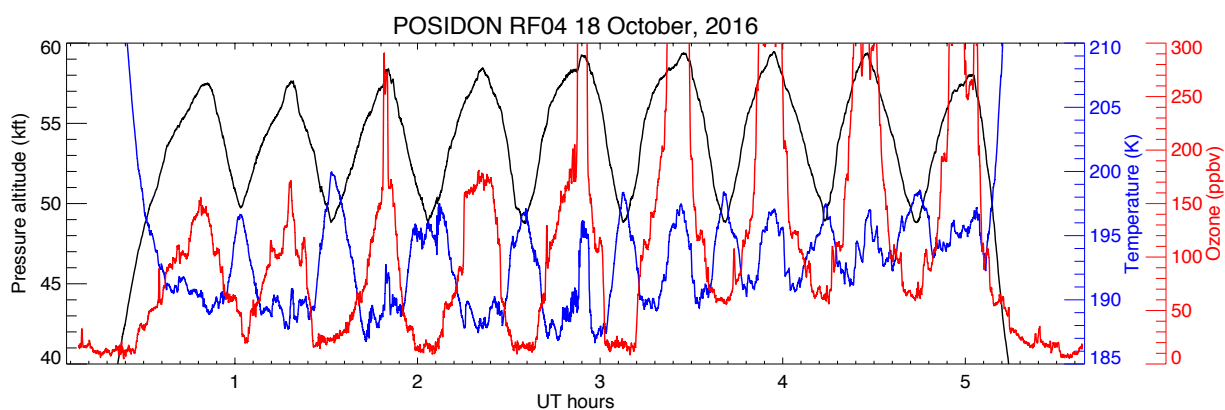


Figure 2. Time series of geometric altitude, static temperature, and ozone mixing ratio.

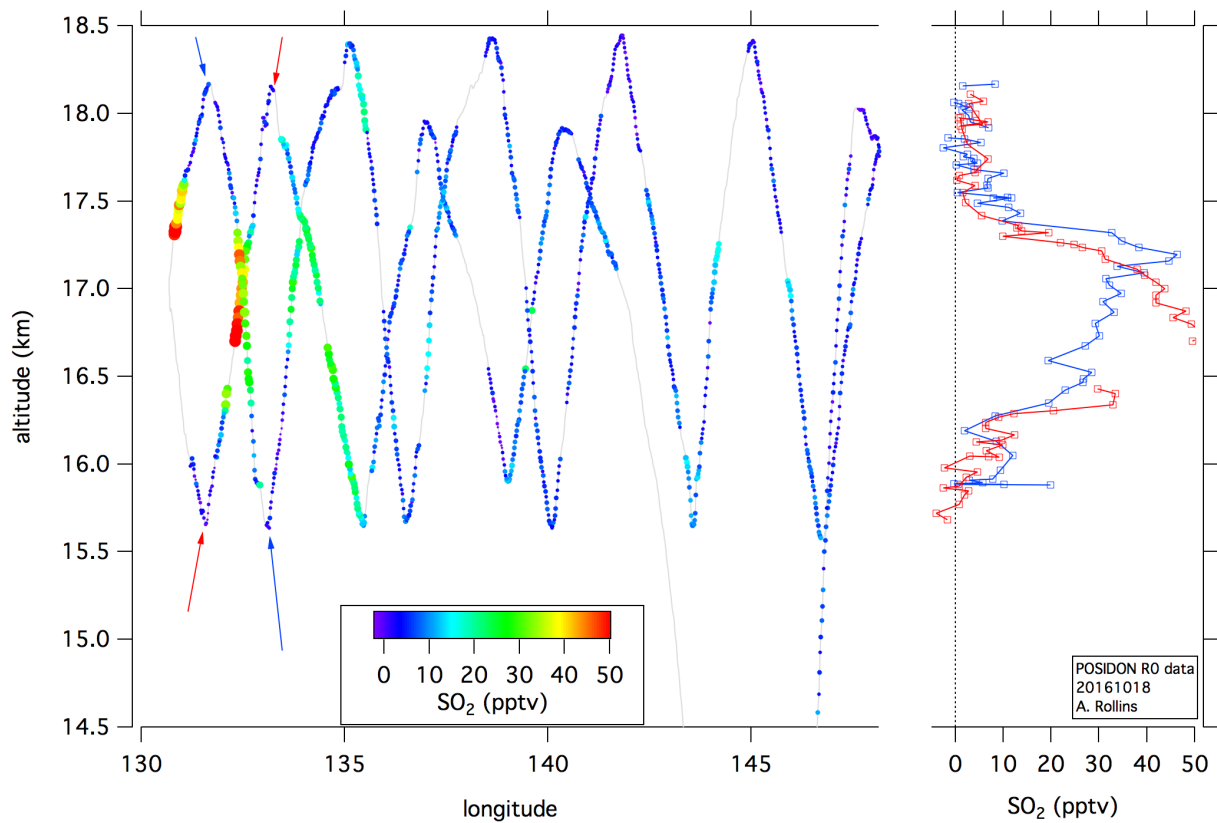


Figure 3. Cross section of measured SO₂ mixing ratio versus longitude and height along the flight track. A layer between about 16 and 17.5 km with enhanced SO₂ (right panel) was apparent at the west end of the flight track. (Courtesy Drew Rollins.)